CREDIT HANDLING IN AN ANONYMOUS TRADING SYSTEM

RELATED APPLICATION

This is a continuation-in-part of U.S. Patent Application Serial No. 09/603,514, filed June 23, 2000, priority of which is claimed under 35 U.S. §120.

FIELD OF THE INVENTION

This invention relates to electronic brokerage systems and in particular to systems in which counterparties trade anonymously within fixed credit limits. Such systems may trade financial instruments such as foreign exchange and forward rate agreements. The invention is particularly concerned with the handling of credit limits.

BACKGROUND TO THE INVENTION

A number of anonymous trading systems are known in the art. EP-A-0,399,850, EP-A-0,406,026 and EP-A-0,411,748 all assigned to Reuters Ltd disclose aspects of an automated matching system in which a host computer maintains a central database of bids and offers submitted by terminals connected to the host via a network. The host also maintains records of credit limits between each trading bank and the possible counterparties with which it is willing to trade. The host computer uses information in its central database to match bids and offers and buy and sell orders based on matching criteria which include the counter party credit limits.

Generally, counterparty credit limits are set for each bank or each trading floor and the host computer establishes a gross counter party credit limit for each possible pair of counterparties. The gross counter party credit limit is the minimum amount of remaining credit between two counterparties.

A trader's terminal will display a subset of the trading book, typically the best few bids and offers. These will be updated periodically to ensure that the trader sees the true state of the market.

A problem with the system outlined above is that the trader sees the bids and offers irrespective of whether he has sufficient credit with the counter party submitting that bid or offer to trade. As a result, a trader can attempt to trade when there is no available credit. As the system is anonymous the trader has no knowledge of the counterparty until a trade as been completed and so, when he hits a bid or offer, has no idea as to whether it is likely to be accepted or rejected for lack of credit. This is extremely frustrating for a trader, particularly in a fast moving market in which trading opportunities can easily be lost. The problem arises as the host computer only checks available credit after a deal has been proposed and a potential match identified.

This problem was solved in WO93/15467 now assigned to EBS Dealing Resources inc. Instead of displaying the actual trading book, or a part of it, to each trader, a different market view is shown to each trader in which bids and offers from counterparties which whom they have insufficient or no credit are screened out. Thus, the trader only sees prices with which he knows he can deal.

The architecture of the system of WO93/15467 is very different from the of the Reuters system and is based on a distributed network with a number of arbitrators which perform matching. Actual credit limits are stored at local bank nodes to which each of a bank's trading terminals are connected ensuring that sensitive credit data does not leave the bank's physical site. The actual trading book is sent

by the arbitrators to the market distributor. The market distributor forms a market view specific to a given trading floor and sends it to the relevant bank node. A different market view may be formed for each trading floor depending on credit criteria. Thus, the market view which is distributed to each of the bank nodes is the complete market view with credit screening taking place, the market distributor to filter out any prices with which the bank, or a given trading floor within the bank, has insufficient credit.

In addition, the market distributers also have limited credit information, maintaining a credit matrix which may store a simple "yes-no" credit indicator for given counterparties. When a match is made, the prices having already been screened for credit, the bank node will make a second credit check using the credit matrix to see whether any previously extended credit has already been exhausted.

While both the above systems have been used successfully in the financial trading markets for a number of years, they both suffer from the disadvantage that they require banks to tie up large amounts of credit in one area of their trading activities. A typical bank will be trading a number of financial instruments and a number of different markets and will want to trade up to its credit limits in each trading day. If one particular market is quiet it will want to be able to divert the credit assigned to that market to a different field. Similarly, if a particular market is very active it will want to be able to take advantage of that activity. It is desirable therefore, to minimise the amount of credit tied up and for it to reflect the actual exposure of the invention.

SUMMARY OF THE INVENTION

The invention aims to overcome this disadvantage by reducing the amount of credit that need be maintained in the anonymous trading system. and in its broadest form provides for the netting of trades between counterparties. Thus, if a party sells an amount to a counterparty and later buys from the same counterparty, the available credit of each party with the other is decremented only by the difference between the trades or the net trade.

The invention provides an anonymous trading system for trading financial instruments between traders for storing credit limits available for trades between each trader or group of traders and possible counterparty traders or groups of traders and credit adjustment means for adjusting the credit available between a given party and a counterparty following a trade with that counterparty, the credit adjustment means calculating the change in exposure to the party resulting from the trade and adjusting the credit limits accordingly, whereby trades between a given trader and each counterparty are netted.

Embodiments of the invention have the advantage that the amount of credit that must be allocated specifically to an anonymous trading system by a bank may be reduced without reducing the dealing capacity. This means that more credit is available to the bank for allocation to other trading areas as so the overall trading capacity can be increased without varying credit limits.

Embodiments of the invention also have the advantage that the netting of credit more closely resembles the actual risk to which a bank is exposed. In the prior art, a sale

of $A followed by a purchase of $B from the same counterparty would have reduced the credit available with that counterparty by $A-B which equals the actual amount of risk to which one party is exposed if the other should default.

Preferably, the order input means, for example trader terminals for a given trading floor are connected to a Trading Agent node connected to the communications network, wherein the credit limit storage means and the credit adjustment means for a given trading floor are resident at the trading agent node to which the trading floor is attached.

In each embodiment of the invention, one of a number of netting regimes may be adopted. A given party may designate a given counterparty or counterparties as netting credit groups. Netting may be performed on a per instrument basis or on a cross instrument basis.

Netting may be by settlement date, by time bucket or by total credit exposure.

In one embodiment of the invention, netting is by settlement date. Each netted currency exposure is calculated and then converted into the credit limit base currency equivalent if necessary. If the exposure is negative, meaning that the party owes the currency, then the exposure is considered to be zero if netting is on a per instrument basis. Positive credit limit currency equivalent amounts are added together to give the total credit utilisation for that value date for that instrument.

In a further preferred embodiment, settlement date netting is applied on a cross instrument basis. Exposures are calculated in the same manner as the per instrument basis above but a negative exposure is only considered to be zero if the sum of all the exposures across all the instruments is negative.

Instead of netting on the basis of a specific settlement day when there is a delivery of currency for value on that date, netting may be performed within a specific floor-defined time bucket. Any trade performed within that bucket is included in the currency exposure calculations. Netting by time bucket may be formed on a cross instrument basis.

In one preferred embodiment of the invention netting is performed irrespective of trade date according to the total credit exposure. This may be performed either on a per instrument or cross instrument basis.

BRIEF DESCRIPTION OF THE DRAWINGS

An embodiment of the invention will now be described, by way of example only, and with reference to the accompanying drawings, in which:

Figure 1 is an overview of a trading system embodying the invention;

Figure 2 shows the flow of messages when a new quote is submitted in the system;

Figure 3 depicts the production of a market view to traders;

Figure 4 shows the flow of messages when a trader submits a buy or sell order;

Figure 5 shows the flow of messages to update broker nodes following a buy or sell order;

Figure 6 shows the flow of messages when a broker updates a quote;

Figure 7 shows the deal execution process;

Figure 8 shows the message flow in a global credit environment;

Figure 9 is a simple example of how credit exposure is calculated according to the invention;

Figure 10 is a more complex example of how credit exposure is calculated according to the present invention ;

Figure 11 is an example of how price distribution is varied as a result of netted trades;

Figure 12 shows the effect on credit limits of the trades of figure 9 calculated by the prior art method;

Figure 13 illustrates netting between different levels in bank hierarchies;

Figure 14 illustrates a parent or hypothetical parent for a bank, Bank B and;

Figure 15 illustrates a parent or hypothetical parent for a second bank, Bank A;

DESCRIPTION OF PREFERRED EMBODIMENT

The present invention will be described with reference to the dealing architecture illustrated in figures 1 to 6 and which will be hereinafter described. However, it should be understood that the invention is not limited to that architecture but could be implemented in any anonymous trading system. For example, it could be implemented on either of the Reuters and EBS Dealing Resources prior art systems known in the art and referred to earlier.

The electronic brokerage system to be described provides a platform for trading at least the following instruments: FX (Foreign Exchange) Spot, FRA's, and Forwards and also FX Forwards, CFDs, short-dated government and/or central bank paper, commercial bills, CDs, inter-bank deposits, commercial paper, repos, interest-rate futures, swaps, options and a miscellany of tailor-made variants on these basic products. These are all referred to as financial instruments. It may also be used for trading non-financial products such as commodities.

Traders at trader terminals are connected to a communications network which allows electronic messages to be passed between terminals, submit quotes and hits which are then passed on to each of a plurality of broker nodes throughout the system. A quote is a bid or offer order submitted by a trader to "make a market" and is distributed to other traders as part of a market view. Quotes are thus orders visible to other traders. A hit is a buy or sell order submitted by a trader wishing to create a deal on the basis of a price displayed on his market view derived from one or more quotes. Hits are orders which are invisible to other traders.

The computer trading system of Figure 1 comprises a plurality of trading agents 10 each connected to at least one of a plurality of broker nodes 12. Each trading agent is the means by which the trader terminals access the trading system with a given trader terminal being attached to one or more trading agents.

Trader terminals (not shown) may be workstations or other computer terminals configured to generate and submit

electronic price quotation messages including bid and/or offer prices, quotes and orders (usually through use of a specialised key pad) and to communicate market view data, including price and amount available, for financial instruments to be traded. The communication is usually by display but could also be by printing the information, voice synthesis or otherwise. The trader terminals are one example of order input devices. Orders may be input manually by traders or automatically, for example by pre-programmed instruction to submit an order for when the market reaches a certain condition.

Traders are typically grouped as part of a financial institution, such as a bank, which arranges traders as part of a trading floor. A trading floor is a group of traders under common control of a trading floor administrator who allocates credit lines for the trading floor against other trading floors. The market view for a trader, or group of traders, is the market information (price, volume, etc.) That the traders can see that reflect the market. The market views are preferably pre-screened for credit compatibility, as described in WO/93/15467. Thus, traders only see displayed quotes with which they can trade. As well as extending credit to a trading floor, credit may be extended to a bank as a whole (many banks have several trading floors indifferent locations), or to groups of trading floors.

The system is an anonymous trading system in which the market views produced by the brokers comprise price and amount information without identifying the source of the price. The prices displayed for available bids and offers and the amounts available at those prices, are thus aggregates of one or more quotes. Only the quotes of

parties satisfying the pre-screen credit criteria are included in the aggregate price displayed. The market views produced by the broker nodes thus differ from one trading floor to another depending on the credit allocation.

The trading agent node provides services to a specific trading floor or group of traders. These services include providing access to the network for each trading work station, completing deals, producing deal tickets and maintaining historical dealing information for traders. Each trading agent node must connect to at least one broker node to access the trading system. A group of trader terminals thus connects to a trading agent 10 to access the system.

Each Broker node 12 provides the basic order matching and price distribution services. The Broker nodes are arranged in a structure called a Clique Tree which enables faster communications routing, following very specific but simple rules. The Clique Tree is a network structure where individual nodes are grouped into Cliques, and the Cliques are then arranged into a tree structure. Each Broker can be linked logically to a number of Brokers, which are referred to as its neighbor Brokers. Communication between Brokers is on an equal level, with no "up" or "down" direction in the network.

In the embodiment of figure 1, there are three Cliques: that formed by brokers 12a, 12b and 12c, that formed by brokers 12b, 12d, 12e and 12f and that formed by brokers 12e and 12f. It will be seen that brokers 12b and 12e are both in two Cliques.

While Trading Agents must be connected to at least one Broker node, they are not members of the Clique Tree, but remain outside the structure. A Trading Agent connected to multiple Broker nodes will receive multiple sets of market prices. Even though the price information from different Broker nodes can be substantially the same, the information may be received at different intervals. A Trading Agent will send a given trading order to only one Broker node.

The term Broker node is used to describe a computer arranged as a physical or logical node in a computer network providing a broking function. The basic broking function is the storing of quotes, providing the quotes to traders in the form of a market view and matching quotes and orders. The Broker nodes in the described embodiment also perform further functions, but these are not essential features of what is defined as a Broker node.

Thus, the broker nodes each provide a matching engine which is connected to the network for matching submitted bids and offers and, when a match is made, for executing deals. They also perform the function of market distributors distributing price messages to the trader terminals in response to the price quotation messages and the matching engine. Thus, brokers distribute prices to create market views which are aggregations of quotes in the order book. Within the context of the present invention it is preferred that the matching and market distribution functions are amalgamated in the broking node but the invention is equally applicable to systems in which the functions are separate and performed at geographically and/or logically separate locations. An example of such a system is WO93/15467 referred to earlier.

The Broker nodes are equal to each other, and perform the same functions. The arrangement of the network or their position in it is transparent to the broker nodes. They only need to know about their neighbours. Each Broker node has knowledge of all orders in the market, and is able to match orders as soon as they are submitted. As each Broker node maintains a full list of orders in the market, it is therefore able to customize market views as needed by the Trading Agents and is able to react faster to market information as soon as it is received.

To understand the purpose of the distributed broker node arrangement, price distribution and deal execution will now be described with reference to figure 2.

The deal process begins with one or more traders submitting orders into trader terminals. An order is a dealing request from a trader, with instructions to buy or sell with specific restrictions, such as price and amount. A quote is a persistent order that remains available in the system and is distributed as part of the market price information. Quotes are used to "make the market", and are known to traders as bids or offers. A hit is an order that has "invisible" and "fill or kill" properties("invisible"). Hits are not distributed as part of the market price. A hit does not remain in the system; if it can not be dealt when entered, it is removed.

An Order Book is a list of all the available orders in the market. Since the Quotes are the only available orders, the book consists of a list of Quotes. The Quotes are arranged in a queue in the correct dealing order. The sort order of the queue may vary for different trading

instruments. The default sort order is by price and time. In the system, each Broker node maintains a complete list of all available quotes. In a system such as foreign exchange there will, effectively, be two books, one showing orders to buy and the other showing orders to sell.

The message flow in the system is described by named messages, each carrying appropriate parameters throughout the network. The process of submitting a quote (persistent order) begins when a Trading Agent receives information from a trader workstation that a trader has issued a bid or offer. The Trading Agent then starts the quote submission process. When the Trading Agent receives the quote information from the trader workstation, it will create and maintain a context for the quote. It will then send a Quote Submit message to the Broker node that it is connected to. The Broker node will validate the quote and accept it if valid. This first Broker node that receives the quote becomes the "owner" Broker node for this quote. In example shown in Figure 2 this is Broker node 5. This is the only Broker node that can commit the quote to a deal. The Broker node will create a context or "quote object" and sort it into its queue for the correct tradable instrument.

After the quote is placed into its queue, the owner Broker node will then distribute the quote throughout the network by sending QuoteAvailable messages to other Broker nodes. In this example, Broker node 5 sends the QuoteAvailable message to Broker nodes 2 and 6. As each Broker node receives the message, it creates a context (quote object) and sorts it into its queue (order book). It notes in the context which Broker node had sent it the message. After placing it into the queue, the Broker node then sends the QuoteAvailable message on, using broadcast

routing rules, to all neighbours except those in the same clique as the broker who sent the message. Therefore, Broker node 2 sends it to 1, 3 and 4. Broker node 4 then sends it to Broker node 7. At this point, all Broker nodes know about the quote, and update their order books accordingly.

The broadcast routing rules are applied to ensure that network traffic is handled in an efficient manner and to reduce any duplication of message flow.

The broadcast rules are:

1. The Broker node originating information will send it to all of its neighbour Broker nodes.

2. A Broker node receiving the information will send it to all of its neighbours Broker nodes except those in the same clique as the Broker node that sent the information.

3. If a message contains persistent information, such as a quote, the information will be stored with the identifier of the Broker node from which the information was received.

Note that these rules refer to the information, not the message that contains it. For example, information about a quote may be sent to one Broker node in a ProposeDeal message and to another Broker node in a MarketUpdate message. However, the same information is sent to both Broker nodes, and so the above rules apply.

Price distribution is the process of providing market information to the traders at the trader terminals. This

information is created by the Broker nodes and sent to the Trading Agents for distribution to the traders. This process is shown in Figure 3.

Each Broker node will examine its queue of quotes (order book) and calculate a view of the market for each Trading Agent connected to it. This view is built specifically for the trading floor that the agent represents. Views may be different based on credit or other factors. The exact process for determining a market view will vary based on the trading instrument. The view information is sent to the Trading Agent in a MarketView message. It follows, therefore, that each of the brokers holds information about the credit relationships between all parties and counterparties.

Hitting a quote is the basic process of creating a deal between two traders. A hit from one trader is matched to a quote from another trader. This process is shown in the figure 4. The Trading Agent of the trader terminal hitting a price shown on his market view display sends a HitSubmit message to the Broker node. This message targets a price, not a specific quote. The Broker node will scan its queue and find the first quote in the queue that can be matched with the hit. The matching rules may vary based on the trading instrument.

When the hit is matched to a quote, the Broker node will modify its context for the quote, moving the amount matched from "available" to "reserved pending deal". This will prevent the same amount of the quote to be matched with another hit. The Broker node will then send a ProposeDeal message to the Broker node from which it received the quote. This message will target the specific quote. In this

example, the hit comes from a trader connected to a trading agent connected to broker 7. Broker 7 will send the message to Broker 4.

As each Broker node receives the ProposeDeal message, it checks the quote in its queue. If the amount of the proposed deal is still available in the queue, the Broker node performs a similar process as the matching Broker node. The amount of the proposed deal is moved from "available" to "reserved pending deal". The ProposeDeal message is then sent to the Broker node from which it received the quote. In the example, Broker node 4 sends it to Broker node 2. Broker node 2 will then send it to Broker node 5.

The routing of a ProposeDeal message follows targeted routing rules. Targeted routing is used to deliver information to a specific Broker node. Since knowledge of specific Broker nodes is not built into the system, the target is not a specific Broker node, but is the Broker node from which the information originated. For example, a message is not sent to "Broker node 714", but is sent as to "the Broker node originating quote 42". The targeted rules are:

1. A Broker node originating a message about a specific piece of information will send the message to the Broker node from which it received the original information.

2. A Broker node receiving a message about a specific piece of information that it did not originate, will send the message to the Broker node from which it received the original information.

The message will thus follow the path of the original information back to its source. In the example this is from Broker node 7, to Broker node 5, via Broker nodes 4 and 2.

When the Broker node that originally created the quote receives the ProposeDeal message, it performs the same checks and amount reservation as the other brokers. Since this Broker node owns the quote, it has the authority to commit the quote to a deal. The ProposeDeal message represents the authority to commit the hit to the deal. The Broker node will then initiate the deal process by sending a HitAmount message to the Trading Agent that submitted the quote. The deal execution process is described later.

As the deal matching process takes place, it is necessary that the list of quotes maintained at each Broker node be keep up to date. This is accomplished by each Broker node notifying others when it makes a change to a quote, as shown in figure 5.

As each Broker node changes a quote in its queue, it notifies all neighbour Broker nodes except those in the clique from which it received the change. In the example above, Broker node 4 received notice of a change in a quote from Broker node 7 in a ProposeDeal message. It notifies Broker node 2 by sending the ProposeDeal message. Broker node 4 must now notify Broker nodes 1 and 3. This is done by sending a MarketUpdate message to these Broker nodes.

Following the normal routing rules, the information about the quote is distributed to each Broker node in the network. Any Broker node receiving the MarketUpdate message will pass it to all neighbours not in the clique from which

it is received. Note that a Broker node sending a ProposeDeal message should not also send a MarketUpdate message to the same Broker node. This would result in duplicate information being received and the deal amount being reserved twice.

When the deal matching process is completed, as described above, the deal execution process begins. This process completes the deal and commits the traders to a deal. The process is shown in Figure 6. As matches are made and deals initiated, information is made available for traders. This information can be used to inform a trader that a deal is pending. Any given trading application can decide if the trader should be informed. In any case, the information is available.

The Taker's Trading Agent will be notified as soon as the initial match is made and the ProposeDeal message is sent. This agent can notify the traders workstation at this time. This pending deal information may change as the deal confirmation continues. The maker workstation is notified of the pending deal when the maker's Trading Agent checks credit and sends the DealStatusMaker message.

The deal execution process begins when the maker's Trading Agent receives a HitAmount message from its Broker node. This message informs the Agent that a match was made for one of its quotes. The message identifies the quote as well as the amount of the hit, counterparty and the identity of the hit. The Agent will check with the trader workstation to make sure that the quote is still available. The Agent will send a HitAmountWS message to the workstation. The workstation will reply with a HitAmountWK message to show that the workstation is still working and that the trader

did not interrupt the quote. At this point, the trader can no longer interrupt the deal.

The Trading Agent will next check for available credit with the counterparty. The credit check may allow the deal, reduce the amount of the deal or disallow the deal. The Agent will then reduce the available credit by the amount needed for the deal. This reduction in available credit may affect future deals. The maker's Trading Agent will now inform the taker's Trading Agent of the deal by sending a DealStatusMaker message to its Broker node. The message is targeted to the identity of the hit. The network Broker nodes will route the message to the owner Broker node of the hit, and that Broker node will deliver it to the taker's Agent. Once this message is sent, the maker's Agent knows that a deal may have been done, but the deal is in doubt pending a reply. The taker's Trading Agent completes the deal execution process. This part of the process takes place when the Agent receives the DealStatusMaker message from the maker. If the message shows a valid deal, the process continues.

The taker's Trading Agent will next check for available credit with the counterparty in a similar manner as the maker. The credit check may allow the deal, reduce the amount of the deal or disallow the deal. The Agent will then reduce the available credit by the amount needed for the deal. This reduction in available credit may affect future deals. It should be remembered that deals are unlikely to be rejected at this stage as prices shown to traders are pre-screened for credit. The taker's Trading Agent will now log the deal to its disk. As soon as the information is committed to persistent storage, the deal is done. Any checks on the deal status will now show a binding deal. The

agent will now notify the trader, print a deal ticket and perform any other post deal processing. At this point, the deal is done but the maker doesn't yet know. As soon as the deal is done, the taker's Trading Agent will notify the maker by sending a DealStatusTaker message to its Broker node. This message is targeted to the quote and will be routed to the maker's Agent.

The DealStatusTaker message contains final information about the deal, and therefore the final changes to the quote. This information is used by the network Broker nodes and the Trading Agent. As the DealStatusTaker message is routed through the Broker nodes, each routing Broker node will use the information to update its quote context. The amount of the deal is moved from "reserved" to "complete". The portion not done is moved from "reserved" to "available" if the quote is still active. It will then notify other Broker nodes of the changes and of the deal by sending a MarketUpdate message to all other Broker nodes using network routing rules.

When the DealStatusTaker message gets to the owner Broker node of the quote, it will send it to the Trading Agent. The Agent will record the deal to disk. At this point the deal is no longer in doubt. The Agent will notify the trader, print a ticket and perform any other processing that is required. Some trading instruments may require additional information to be exchanged for a deal. An example of this is the settlement instructions for EBS spot F/X. This type of information is sent in a DealInformation message. After the deal is processed, the Agents can develop this information. The DealInformation message is sent to the Broker node. The network Broker nodes will then route the message to the other Agent where the information is

processed as required by the instrument. A deal is thus completed.

Once the deal is complete, the two parties will know the identity of their respective counterparty for the first time. The identity will be displayed on their terminal screen and shown, for example, in a listing of deals performed in that trading session as well as printed on the deal ticket and logged to disk. Each of these comprises a means for identifying to each of the parties to an executed deal the counterparty to the deal.

The manner in which credit is handled in the system described will now be considered in more detail.

As mentioned previously, the system screens prices and deals matching using credit, as a result of which all prices shown to a deal should be available for trading. It will be understood from the foregoing description that this requires each broker to have sufficient credit information to be able to make credit decisions. This is because the brokers are responsible for forming the market view which is distributed to communicating trading agents. The actual credit data is very complex and can vary by product and institution. For example, the concept of credit in an F/X trading system is straightforward as it is a spot market. However, for a product such as FRA's it is more complex as deals are done over a variety of time periods. Some banks may prefer to assign credit to a counterparty over the whole of the range of their trading activities whereas some banks will prefer to assign credit to counterparties for a given financial instrument.

The system uses a single numeric value for each combination of trading floor, counterparty trading floor and tradable element. The purpose of the numerical value is to determine whether the two floors have credit to deal in a particular element. The meaning of the numerical value is specific to the instrument being traded. For example, spot F/X uses the value as a yes/no flag (1 or 0) whereas in Forward Rate Agreements (FRA) the value is used as a bit mask for FRABBDA/ISDA decisions. Other instruments will have other meanings. The credit is bi-lateral. Credit must exist between two floors for any dealing activity to take place. The credit check is made for a given trading element or pattern of trading elements as determined by the instrument. As the system is bilateral the broker will compare two credit values; that given by the first floor to the second and that given by the second floor to the first. If the values are compatible, the dealing operation is allowed. The meaning of compatible will be determined by the instrument. In terms of spot F/X if the amount proposed for the trade is lower or equal to the lowest of the two credit values the deal can proceed. Even if the deal is greater than the lowest credit value it may still proceed but only for a part of the proposed deal amount equal to the lowest credit value.

The full credit information for a credit floor is originated for a trading agent that has credit authority for a trading floor. This agent only has part of the total information; that relating to its own trading floor although it is possible that more that one trading floor is connected to a Trading Agent. When the credit information changes, the Trading Agent will sent a CreditUpdate message to its broker. The broker will combine the information from the Agent into its total credit matrix and pass the message to

neighbour brokers as a broadcast message following the rules set out earlier. Each broker will also store a record of from where the credit information for a given floor came from.

In the prior art system described in WO93/15467 the bank node holds the credit authority for a floor and is also responsible for dealing activity for the floor. The deal execution process described earlier is based on this credit model which is known as local credit.

During the deal execution the Trading Agent is presented with a potential deal. The Agent will examine the details of the deal and determine how much credit is required to complete the deal. It will check the available credit and, if it is insufficient the Agent may reduce the amount of the deal or disallow the deal. The amount of credit actually needed (the whole or reduced amount) is reserved from the pool of available credit. This credit is not available for other deals. If this reduces the available credit for other deals below the dealing threshold the Agent will send a CreditUpdate message to notify the broker that credit is no longer available.

When the deal is completed, the maker's Agent will be notified with a DealStatusTaker message. The Taker's Agent will then be aware of the completed deal. The Agent will then determine the credit that was actually used by the deal. This credit will be removed from the credit pool as consumed credit. Any remaining amount from the original reservation will be returned to the original pool.

As an alternative to local credit, a bank may adopt a Global Credit Model in which the Trading Agent that holds

the credit authority for a floor is not the same Agent that performs the dealing activity for that floor. The Agent with credit authority may, but does not have to, perform dealing activity for a floor. This arrangement allows all the floors of an institution to share a common pool of credit and the creation of separated credit nodes within the network for some floors. The deal execution process for this type of credit arrangement is more complicated than for the local credit example described earlier.

Figure 8 shows the credit message flow during deal execution with global credit.

The credit distribution process is the same as in the local credit example in that credit information is still distributed to all brokers. Each broker knows where the information came from and can route a message back to the Trading Agent with credit authority.

In the example of figure 7, the Maker and Taker Trading Agents 100, 110 do not have credit authority for their floors. Credit must therefore be confirmed by the two Trading Agents 120, 130 which do have that authority and which may be referred to as Maker and Taker Credit Agents.

When the Maker Trading Agent 100 processes a deal it will first check that the quote is still available in the manner described previously and it notifies the dealer of the pending deal. However, it cannot check the credit position itself and so does not send the DealStatusMaker message itself. Instead, a DealCreditMaker message 140 is sent to the broker 150 to which the Trading Agent is attached. The broker 150 routes the DealCreditMaker message 140 to the Maker Credit Agent 120, which is the source of

credit information for the trading floor to which the Trading Agent 100 is performing the dealing activity. Once the Maker Credit Agent 120 has performed the credit check as described previously, it sends the DealStatusMaker message 160 to broker 170.

The DealStatusMaker message 160 is routed by the broker 170 not to the Taker Trading Agent but to the source of credit for the taker, in this case the two are not the same and the DealStatusMaker message is routed to the Taker Credit Agent 130. The Taker Credit Agent 130 then performs credit checking as described previously and sends a DealCreditTaker message 180 to the broker 190 to which the Taker Credit Agent is connected. Of course, if the Taker Trading Agent has credit information for the trading floor the DealCreditTaker message 180 is not necessary.

The DealCreditTaker message 180 is routed by the broker network to the source of the original hit using the targeted routing rules described previously.

When the Trading Agent 110 that originally proposed the deal received the DealCreditTaker message 180 the deal is done and logged at the Taker Trading Agent and the deal execution process carries on as described earlier with respect to figure 6.

The Maker and Taker Credit Agents 120, 130 perform credit reservation in the same manner as described in the local credit example. The Maker Credit Agent reserves credit when it receives the DealCreditMaker message and the Taker Credit Agent reserves the credit when it receives the DealStatusMaker message 160. Credit consumption is then performed when the Maker and Taker Credit Agents 120, 130

receive the DealStatusTaker message 200 from the Taker Trading Agent 110.

It may be desired for more that one Trading Agent to hold the credit authority for a floor to increase reliability and performance. In such a case, any one such Credit Agent may confirm a deal. It is the responsibility of those Agents to communicate and keep the credit pool correct between themselves. This process is specific to an instrument or institution. Each broker will receive multiple CreditUpdate messages for the same floor. The brokers must decide which message to accept. The broker will examine a "hop count" in the message to determine which message came from the closest source. The message with the higher hop count is not processed and is not routed.

The Credit Agent for a floor or institution has to maintain the pool of available credit and adjust the credit information as credit is used and restored. The manner in which this is done is specific both to the institution and the instrument being traded.

One reason for a bank adopting a global approach to credit is to increase the flexibility available in trading. If a bank comprises several floors each of which have a preassigned amount of credit with various counterparties, a situation can arise in which some of the floors trade up to their credit limits but others do not. Those floors which went up to their limits would have liked access to the unused credit on the other floors to maximise trading within the banks overall trading limit with a given party. That overall trading limit may not be confined to a single trading instrument but cover the range of the bank's

activities, some of which may be traded on anonymous electronic systems and others of which may not.

Whichever of the global or local credit models is used it is undesirable and inflexible to tie up more credit in the electronic broking system than is absolutely necessary. The credit adjustment made in prior art systems on completion of a trade is completely independent of any other trading activities that has taken place. Thus, if bank A sells $10M to bank B and then buys $9M from bank B, both parties' credit will be drawn down by $19M, the combined value of the two transaction. However, this is not a fair representation of the risk undertaken by wither party as the net exposure is $1M. This is undesirable as the main purpose of credit limits is to limit the exposure of a bank. However, in this example the exposure is far within the exposure the bank considers acceptable and the effect is to prevent the bank from trading up to a level of risk is considers appropriate.

In an embodiment of the invention this problem is overcome by netting when adjusting utilised credit after deal execution. Under this arrangement the sense of the deal with a counterparty, that is whether it is a but or a sell is taken into account when adjusting utilised credit. This has the advantage of better reflecting the time level of risk to which the bank is exposed and allows more trading to be undertaken within the confines of the set credit limits.

Within the trading system described, institutions may decide whether or not to net with other institutions. This, a given institution may define netting credit groups. The trading system described may trade a number of different

instruments, such as spot FX, FRA's etc. Netting may be on a per instrument basis or on a cross instrument basis. Where an institution defines netting as being on a cross instrument basis it may designate which instruments are to be included for netting calculation purposes.

In considering which trades may be netted, the settlement date of the trade is also an issue. An institution may net by settlement date, by time bucket or by total credit exposure. Each of these may be on a per instrument or cross instrument basis and each will now be briefly considered.

Figure 9 illustrates a simple example of netting by settlement date on a per instrument basis. Whenever an instrument is traded such that there is a delivery of currency or value on a specific date, the settlement date, it is possible for that delivery of currency to be netting against a receipt of that same currency for value on the same specific date with the same counterparty.

In the figure 9 example, Bank A buys EUR 10 million v USD of a rate of 1.07 (selling USD 10, 700, 000) for value August 3 2000 from Bank B. Later on, Bank A sells EUR 10, million v USD at a rate of 1.08 (buying USD 10, 800,000) for value August 3 2000, from Bank B.

If the two parties have a netting agreement, there will be no EUR payment as the net result of the two EUR transactions is +10M -10M = 0 . The net result of the two USD transactions is a payment from Bank B to Bank A of USD 100,000 representing the difference between the USD sale and purchase. Thus, the amount of credit utilised or the total exposure to Bank A is USD 100,000. This assumes that USD are

the credit limit currency. If not, the exposure amount is converted into the credit limit currency at a credit limit currency conversion rate which is stored within the trading system.

Figure 10 shows a more complex example. In this example, Bank A buys the same EUR 10M v USD as in the figure 9 example. However, instead of selling the EUR 10M v USD, the sale is v JPY (Japanese Yen) at a rate of 125, buying JPY 1,250M again for value 3 August 2000 from Bank B. The net result of the two transactions if the banks have a netting agreement, from Bank A's perspective is as follows:

USD exposure = 0

Bank A has only sold US dollars and therefore has no USD credit exposure.

EUR exposure = 0

Bank A has bought and sold EUR 10M and the total exposure is therefore zero.

JPY exposure = JPY1,250M

This is the amount owed to Bank A by Bank B and so the amount of credit exposure.

Thus, the amount of credit used by bank A is the JPY exposure amount converted into USD, assuming that USD is the credit limit currency. If one were to assume a rate of JPY/USD = 118 then the exposure is USD 10,593,220. Thus, each netted currency exposure is calculated for each value date and then converted into the credit limit base currency

equivalent. If the exposure is negative, in which cased Bank A owes the currency, then this is considered to be zero. The is the case if there is no cross instrument netting. The positive credit limit currency equivalent amounts are added together and this is the total credit utilisation for that value date for that instrument.

In the trading system described, prices shown to traders are pre-screened for credit. Thus, if an order has been put into the system and there is insufficient credit with the owner of that order, the quote is not displayed to the trader. Netting affects the pre-screening for credit. Considering a single sided example for simplicity, if Institution A has a limit for trades with Institution B of USD 10M and buys USD 10M, there is no credit left with that Institution and offers from that counterparty must be screened out and not shown to Bank A's traders. However, as Banks A and B have a netting agreement, bids from Bank B must be shown. If Bank B were now to bid USD 10M, offering to buy 10M from Bank A, conclusion of the transaction would reduce Bank A's exposure to Bank B to zero.

Figure 11 shows how this works for the two currency pair of example of figure 10. Assume first, that the Institution gave a credit limit of USD 11M to the credit group. The first trade, of USD 10.7M has used all but USD 300,000 of this credit which is below the permitted minimum deal size. The system must only show bids of JPY v any other currency. Any selling of JPY up to JPY 1,250M v any currency other that USD would result in, at worse, the same net exposure. The selling of JPY 2,500M v USD would result in a reduction in exposure.

The examples given above have used spot FX as the instrument. The system will work with any single instrument.

The examples given above related only to netting by settlement date on a per instrument basis, explicitly addressing spot FX. Netting can be done cross instrument provided that the settlement date of the delivery of the currency is the same. The general rule of cross instrument netting by settlement date is the same as that for the per instrument example. Each netted currency exposure is calculated for each value date and is then converted into the credit limit currency equivalent. The different is that in addition to spot FX, other designated instruments are included in this calculation. If the exposure is negative, so that Bank A owes the currency, then the amount is considered to be zero. The positive credit limit currency equivalent amounts are added together and this is the total credit utilisation for that value date.

Instead of netting by settlement date, instruments may be traded such that there is a delivery of currency for a value on a date within a specific floor-timed window, often referred to as a time bucket. Delivery of currency may be netted against a receipt of that same currency for value on another, or the same, date within that same specific floor-defined time bucket with the same counterparty.

By way of example, Bank A may establish a series of three-month time buckets. Assuming that the date is 26 April 2000 and the spot date is 28 April 2000. The three month time buckets will end on 28 July 2000, 28 October 2000, 28 January 2001 etc. Going back to the example of figure 9, Bank A buys EUR 10M v USD at a rate of 10.07 (selling USD 10.7M) for value August 3 2000 from Bank B. Later Bank A

sells EUR 10M v USD at a rate of 1.08 (buying USD 10.8M) for value August 10 2000 from Bank B. In the netting settlement date example, there would be no netting possible. However, as both value dates are within the 28 July-28 October time bucket netting is possible. The net result of the transaction is, as in the figure 9 example, no EUR expose using USD 100,000 of credit within that time bucket.

As with the settlement date example, netting by time bucket may be on a cross instrument basis. Thus, whenever instruments are traded as such that there is a delivery of currency for value on a date within a specific floor-defined time bucket, it is possible for that delivery of currency to be netted against the receipt of the same currency for value on another (or the same) date within that same specific floor-defined time bucket with the same counterparty. Again, the general rule is the same as in the settlement date cross instrument example except that trades falling within the same time bucket are eligible for netting.

In all the examples given above, netting has been determined by the value date of the trade. In another alternative, netting may be on the basis of total credit exposure. Thus, whenever an instrument is traded, regardless of the value date, the delivery of currency associated with that instrument may be netted against the receipt of that same currency with the same counterparty. As in previous examples, each currency exposure is calculated and then converted into the credit limit currency equivalent. If that total exposure is negative, the exposure is considered to be zero. If it is positive, then this is the total credit utilisation.

The total credit exposure example may be extended on a cross instrument basis such that whenever multiple instruments are traded, regardless of value date, the delivery of currency associated with those instruments is netted against receipts of that same currency with the same counterparty. Each currency exposure, per instrument, is calculated and totalled. This total is then converted into the credit limit currency equivalent. If that total exposure is negative it is considered to be zero. If it is positive, then this is the total credit utilisation.

Thus, it can be seen that by netting trades between banks the credit available can effectively be increased greatly under some circumstances, correctly reflecting the actual exposure entered into by the bank and enabling more trading in a given trading day than was previously allowable.

Figure 12 shows how the credit limits would have been adjusted if the trades of figure 9 had been applied without netting was performed by prior art systems. Here, each of the two trades would result in the credit limits being decreased by the USD value of the trade such that the total reduction in credit for the two trades would be USD21.5M. Thus, the arrangement of the present invention frees up over USD21M of credit available for further trades compared to the prior art. In turn, institutions need not assign so much credit to the anonymous trading system freeing up further credit for use in other trading activities.

Thus, it can be seen that by netting trades between the credit available can effectively be increased greatly under some circumstances, correctly reflecting the actual exposure

entered into by the bank and enabling more trading in a given trading day than was previously allowable.

In the context of the system described, netting will be performed by the Maker and Taker Trading Agents whether local credit is employed and by the Maker and Taker Credit Agents where global credit is employed or a combination of these two models may be in use.

Whether or not netting can be performed between two counterparties will depend upon whether there is a netting agreement between the parties.

The user defines a set of criteria for the eligibility of Deals to be netted within the system. The criteria include:

the Instrument types to which the agreement applies to;

the Currencies to which the agreement applies to;

the maximum and minimum deal duration that is eligible to be netted under an agreement; and

identifying whether the agreement is an agreement to net to the parent.

The user then can associate Credit Lines with a Net agreement.

The netting arrangement described above is a type of pre-settlement netting. If an agreement includes pre-settlement netting, the user can define whether the pre-settlement netting takes the form of Novation or Close-Out netting.

The system uses the criteria and the credit line information to distinguish the nettable deals form those that are non-nettable. This means that the user can

accurately represent the terms of their netting agreement and its effects on Exposure.

Netting need not be between trading floors having similar status in a bank's hierarchy. Any particular net agreement may apply to many relationships between a user branch structure and various counterparty branches. A particular user branch may be party to the same net agreement with various counterparty branches.

The user can associate as many credit lines as he chooses with a particular net agreement, as long as no two credit lines contain a counterparty branch from the same counterparty hierarchy. This is to simplify the calculation process. An example of this is shown in Figure 13. Assuming that Bank B is the user hierarchy and Bank A and Bank C are two counterparty hierarchies in Figure 13, the user could have the credit lines between Bank B London and Bank A London as well as Bank B Paris and Bank C Frankfurt associated with the same net agreement. (Represented as Netting agreements 1 and 2 in Figure 13).

However, the user could not have Bank B London and Bank A London as well as Bank B Paris and Bank A Paris associated with the same net agreement, (represented by Netting Agreements 1 and 7 in Figure 13).

In all, the following combinations of credit lines from the diagram can be associated with the same particular net agreement:

- 1&2 or 1&4 or 1&6 or 1&8 or
- 3&2 or 3&4 or 3&6 or 3&8 or
- 5&2 or 5&4 or 5&6 or 5&8 or

- 7&2 or 7&4 or 7&6 or 7&8.

The system will not permit any other combinations, such as 1&3 or 1&2&3, to be associated with a particular net agreement.

The user can set up as many net agreements as he wishes with the same currencies, instrument groups, minimum number of days and maximum number of days.

In some cases, a net agreement is enforced between parent level branches. For example, if the user's organisation has a single back office that handles all the payments for several child branches. Then the payments due for transactions conducted at the child branches will be netted at this parent level, rather than at the individual child branch level.

Referring to Figures 14 and 15, Bank B Europe is the parent and could be a hypothetical parent purely for the purpose of aggregating exposures of Bank B London, Bank B Paris and Bank B Frankfurt. An agreement could be established with a counterparty, Bank A London, that nets between Bank B London and Bank B Paris, and Bank A London, at the level of Bank B Europe. E.g. Bank B Europe makes the payments to Bank A London for all netted currencies (and probably un-netted payments too) and receives all netted payments from Bank A London due to Bank B Paris and Bank B London. Therefore the net exposure for these payments would be conceived at Bank B Europe and not the individual child branches. This applies also to the netting of credit.

A similar example can be given where a single user branch nets across several counterparty branches at a parent

level. Referring to Figures 14 and 15, the user can establish a net to parent agreement between Bank B Frankfurt and Bank A Europe, including the children Bank A London and Bank Frankfurt as part of the agreement.

Finally, both the counterparty and the user branch can net at the parent level. Consider Figures 14 and 15. Assuming that the user hierarchy is Bank B and the counterparty is Bank A, a net agreement can be in operation between Bank B London and Bank B Paris, and Bank A London and Bank A Frankfurt, can be netted at the respective parent levels. So, Bank B Europe can net credit for deals done between the following credit lines:

- Bank B Europe - Bank A Europe
- Bank B Europe - Bank A Frankfurt
- Bank B Europe - Bank A London
- Bank B Paris - Bank A Europe
- Bank B Paris - Bank A Frankfurt
- Bank B Paris - Bank A London
- Bank B London - Bank A Europe
- Bank B London - Bank A Frankfurt
- Bank B London - Bank A London

There are two types of pre-settlement netting, Novation netting and Close-out netting. Novation netting is only applicable to FX Deal types. Contracts that meet the definitions and rules of the agreement, that are settling on the same date, in the same currency pair, are legally replaced bty a single contract that represents the netted obligation due/owed on that respective day. As a result of this agreement, if either of the counterparties within the contract was to default on his obligations, the other party would only stand to lose the Replacement Cost of each of the

netted contracts, rather that the total of the Replacement Cost of each individual deal. Hence, under this type of particular agreement, the system must provide the user with the functionality to net both the Replacement Cost on the basis of same currency pair, same settlement date, and the Potential Future Exposure (add-on) for these deals.

Close-out netting can be applied to all deal types that generate a pre-settlement exposure. Contracts included within the agreement, are legally replaced by a single contractual obligation, such that a bank would have either a claim to receive or obligation to pay only the net sum of the positive and negative mark to market values of included transactions in the event a counterparty defaults as a result of bankruptcy, liquidation or similar circumstances. Hence, under this type of agreement, the system must provide the user with the functionality to net both the Replacement Cost, and the Potential Future Exposure (add-on) for included deals across all dates and instrument types.

Through the use of a Pre-Settlement Netting agreement, the user bank has the opportunity to mitigate substantial credit risk, associated with its credit lines. This will enable the user bank to carry out more trading, without overstepping its capital adequacy requirements. This has been discussed above.

Options and the like, the methodology will be generalised to be applicable to all the instrument types traded through the BrokerNet system.

The system provides functionality for the user to define the criteria that makes a deal eligible for Pre-Settlement netting. The user will be able to define the set

of Instrument Types that are eligible the Pre-Settlement netting, as well as the currencies that can be netted.

The system will provide the user with functionality to net Pre-Settlement exposure at parent level. That is, the user can define which child branches in tis own and the counterparty's organisation are eligible for netting, and the exposure will be netted at the parent level for the transactions between the eligible children.

Considering Novation netting further, based upon the netting rules that have been defined within the netting agreements, the system will calculate the appropriate netted pre-settlement exposure for any credit line that is assigned a net agreement with Novation netting if a credit line has been associated with a Novation net agreement, the system will net the pre-settlement exposure for deals that are instrument types that have been associated with the net agreement and are denominated in currency pairs derived from the currencies that are associated with the net agreement.

The system will net the Replacement Cost for all deals settling on the same date for the same currency pair; the Potential Future Exposure (add-on) for all deals settling on the same date for the same currency pair; and multi-branch exposures at an aggregate, parent level for those parent associated with "net to parent" net agreements.

The net Novation pre-settlement exposure calculations will be applied to all credit lines that contain any deal that is eligible for netting. That is, the netting eligible deal contributes to the calculation of pre-settlement exposure for that particular credit line. This will include

Credit lines where the credit entity is a country, country group or ad-hoc group.

The system recalculates net Novation pre-settlement exposures on a daily basis until the exposure matures, and permits the user to retrieve Novation Netting associated attributes for at least 6 months after the date associated with the net settlement exposure value. Users require this historic data to analyse trends in exposure distribution.

Considering Close-out netting further, based upon the netting rules that have been defined within the netting agreements, the system will calculate the appropriate netted pre-settlement exposure for any credit line that is assigned a net agreement with Close-out. Fi a credit line has been associated with a Close-out net agreement, the system will net the pre-settlement exposure for deals that are instrument types that have been associated with the net agreement and are denominated in currency pairs derived from the currencies that are associated with the net agreement.

The system nets the Replacement Cost for all deals settling within the same timeband in the same credit line within the same instrument group that are eligible for the same net agreement;

the Potential Future Exposure (add-on) for all deals settling within the same timeband in the same credit line within the same instrument group that are eligible for the same net agreement; and

net multi-branch exposure at an aggregate, parent level for those parents associated with "net to parent" net agreements.

The net Close-out pre-settlement exposure calculations will be applied to all credit lines that contain any deal that is eligible for netting. That is, the netting eligible deal contributes to the calculation of pre-selected exposure for that particular credit line. This will include Credit lines where the credit entity is a country, country group or ad-hoc group.

In order to aid the calculation process, the system classifies each particular combination of net agreement short name, net agreement currencies, net agreement instrument types, net agreement maximum number of days, net agreement minimum number of days and credit line as a unique net agreement.

The system recalculates net close-out pre-settlement exposures on a daily basis until the exposure matures; and

permits the user to retrieve Close-out Netting associated attributes for at least 6 months after the date associated with the net settlement exposure value. Users require this historic data to analyse trends in exposure distribution.